Impact of widespread adoption of heat pumps on peak demand for electricity, net of wind generation.

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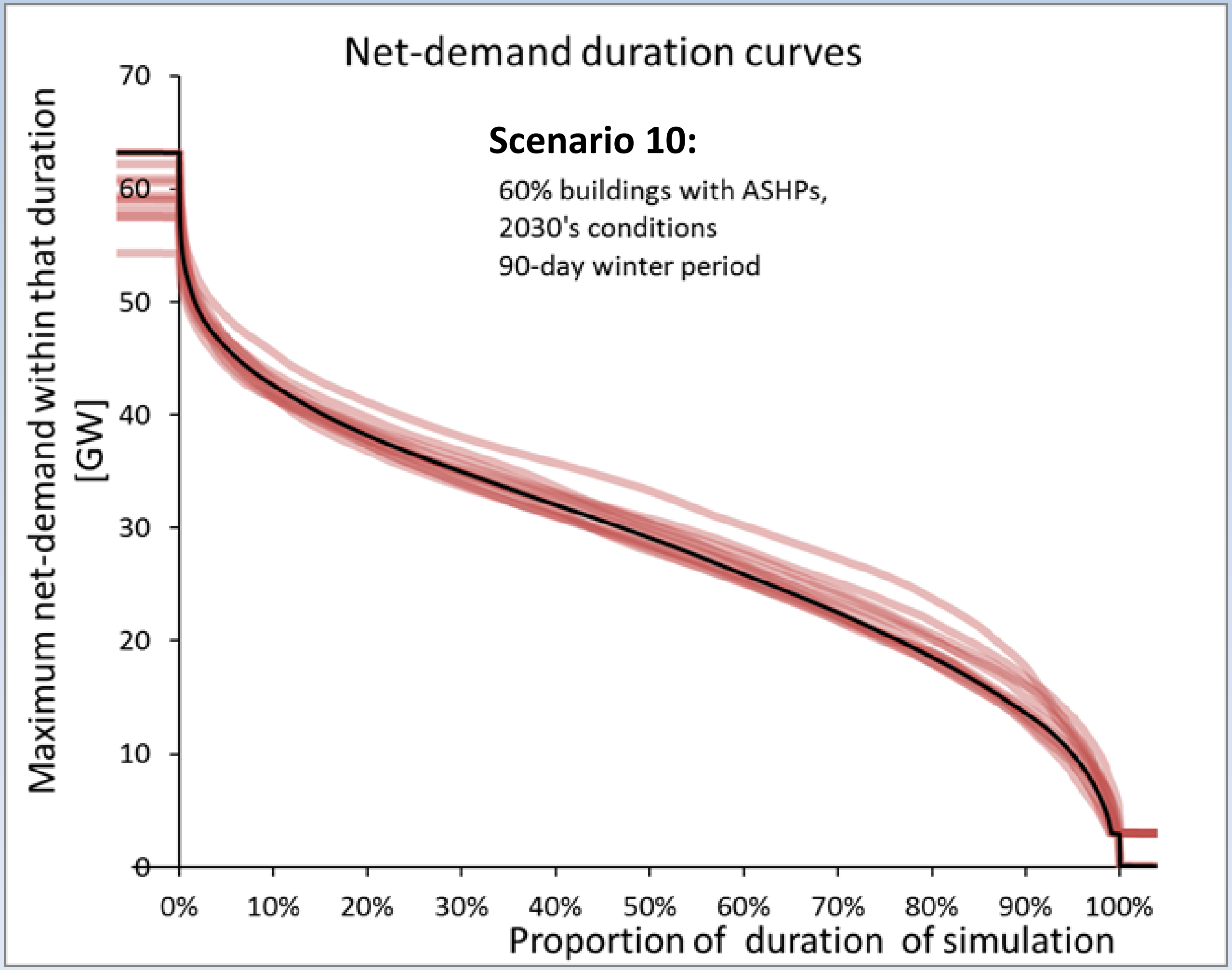
Modelling approach

- Bottom-up, time-step model
- 960 buildings simulated and electrical demands scaled up, proportioned to dwelling types and locations:
  - 5 building types with thermal models
  - 8 regions across UK
  - 8 internal temperature profiles
  - 3 occupancy levels
- Additional random variation
  - Thermal parameters
  - Climate
  - Temperature profile
  - Active occupancy and gains
- Comparison with actual annual heat demand

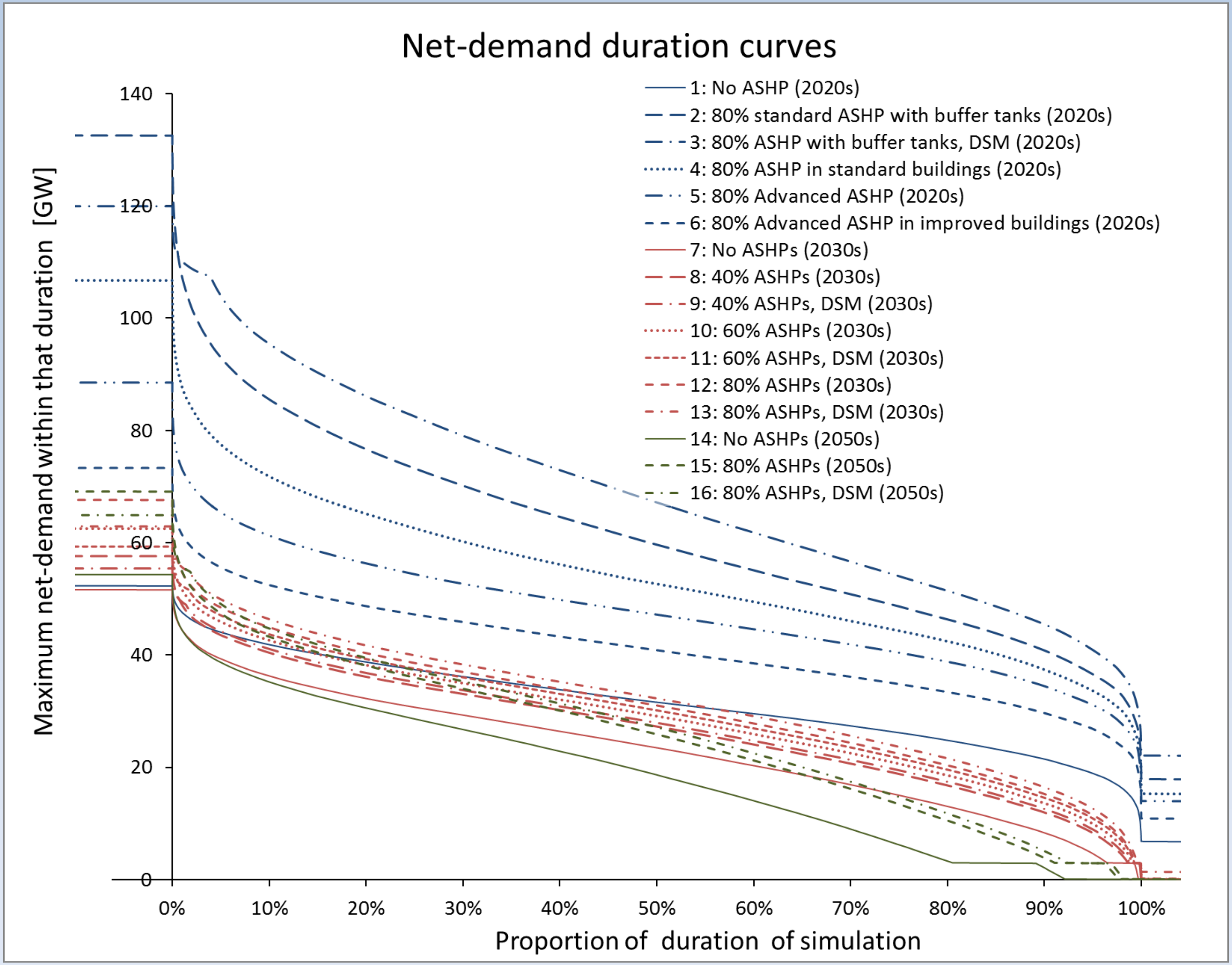
16 sets of assumptions:

	Climate	Wind capacity	Proportion of dwellings with ASHPs	Building thermal performance	ASHP model	Buffer tank?	DSM used?
1			0%				
2			80%		Standard	Yes	No
3	2020s	17GW	80%	Current			Yes
4			80%				No
5			80%				No
6			80%				No
7			0%				
8			40%				No
9			40%			No	Yes
10	2030s	38 GW	60%		Advanced		No
11			60%	Improved			Yes
12			80%				No
13			80%				Yes
14			0%				
15	2050s	59 GW	80%				No
16			80%				Yes

Year to year variation

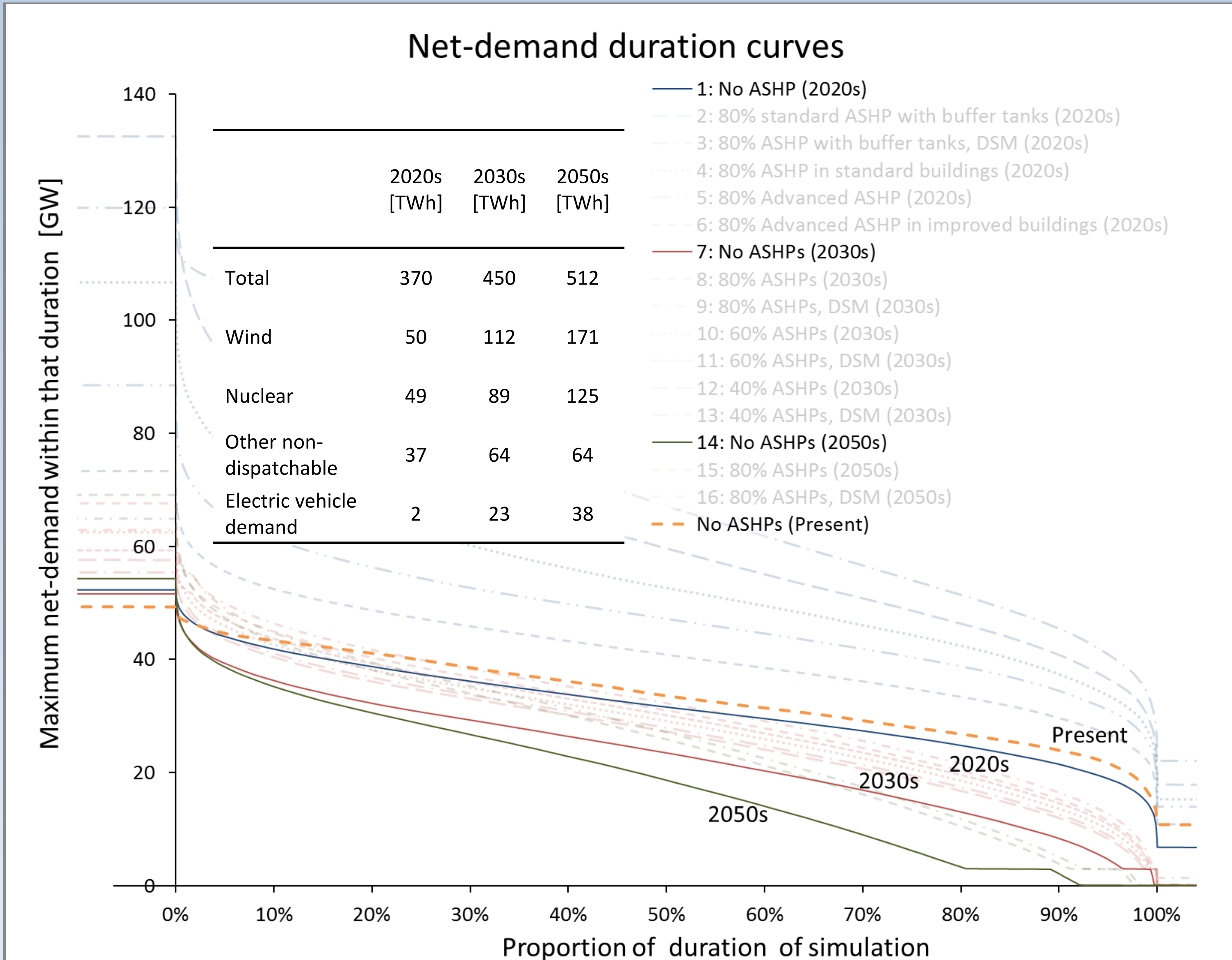


Results



Net-demand duration curves
Maximum net-demand within that duration [GW]
140
120
100
80
60
40
20
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Proportion of duration of simulation
1: No ASHP (2020s)
2: 80% standard ASHP with buffer tanks (2020s)
3: 80% ASHP with buffer tanks, DSM (2020s)
4: 80% ASHP in standard buildings (2020s)
5: 80% Advanced ASHP (2020s)
6: 80% Advanced ASHP in improved buildings (2020s)
7: No ASHPs (2030s)
8: 40% ASHPs (2030s)
9: 40% ASHPs, DSM (2030s)
10: 60% ASHPs (2030s)
11: 60% ASHPs, DSM (2030s)
12: 80% ASHPs (2030s)
13: 80% ASHPs, DSM (2030s)
14: No ASHPs (2050s)
15: 80% ASHPs (2050s)
16: 80% ASHPs, DSM (2050s)

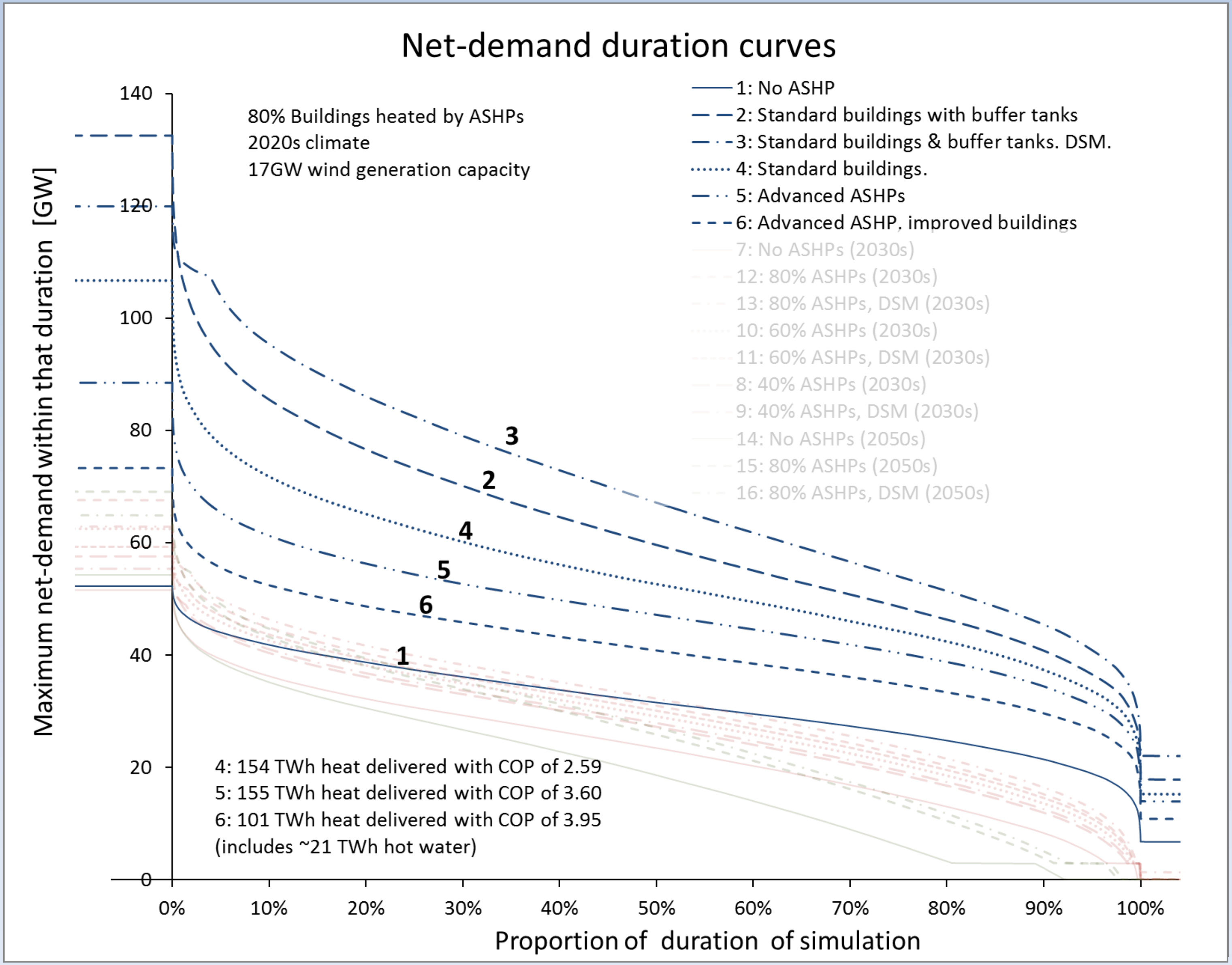
Results



	2020s [TWh]	2030s [TWh]	2050s [TWh]
Total	370	450	512
Wind	50	112	171
Nuclear	49	89	125
Other non-dispatchable	37	64	64
Electric vehicle demand	2	23	38

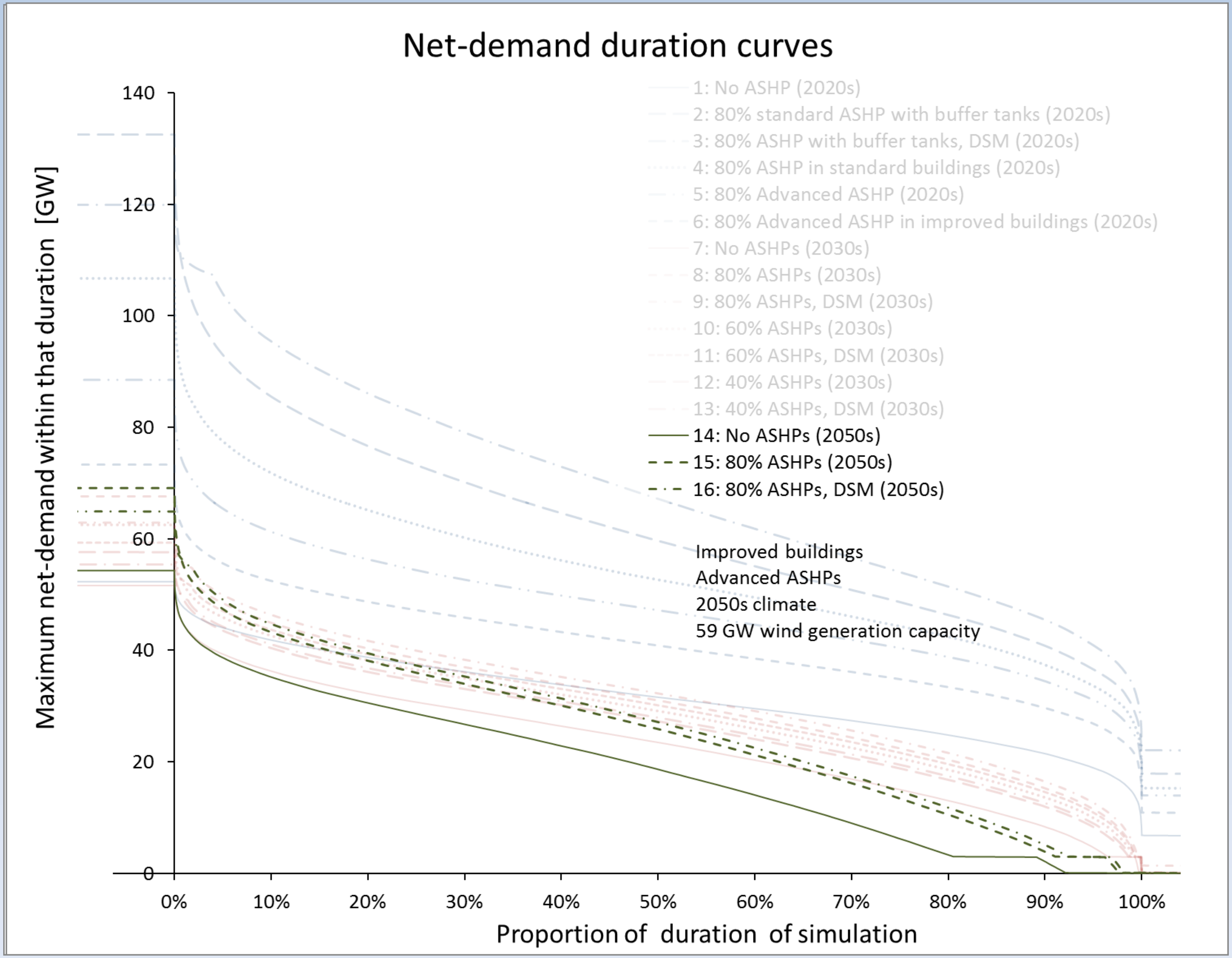
Results

Increase [MW]
80200
67600
54400
36200
21000

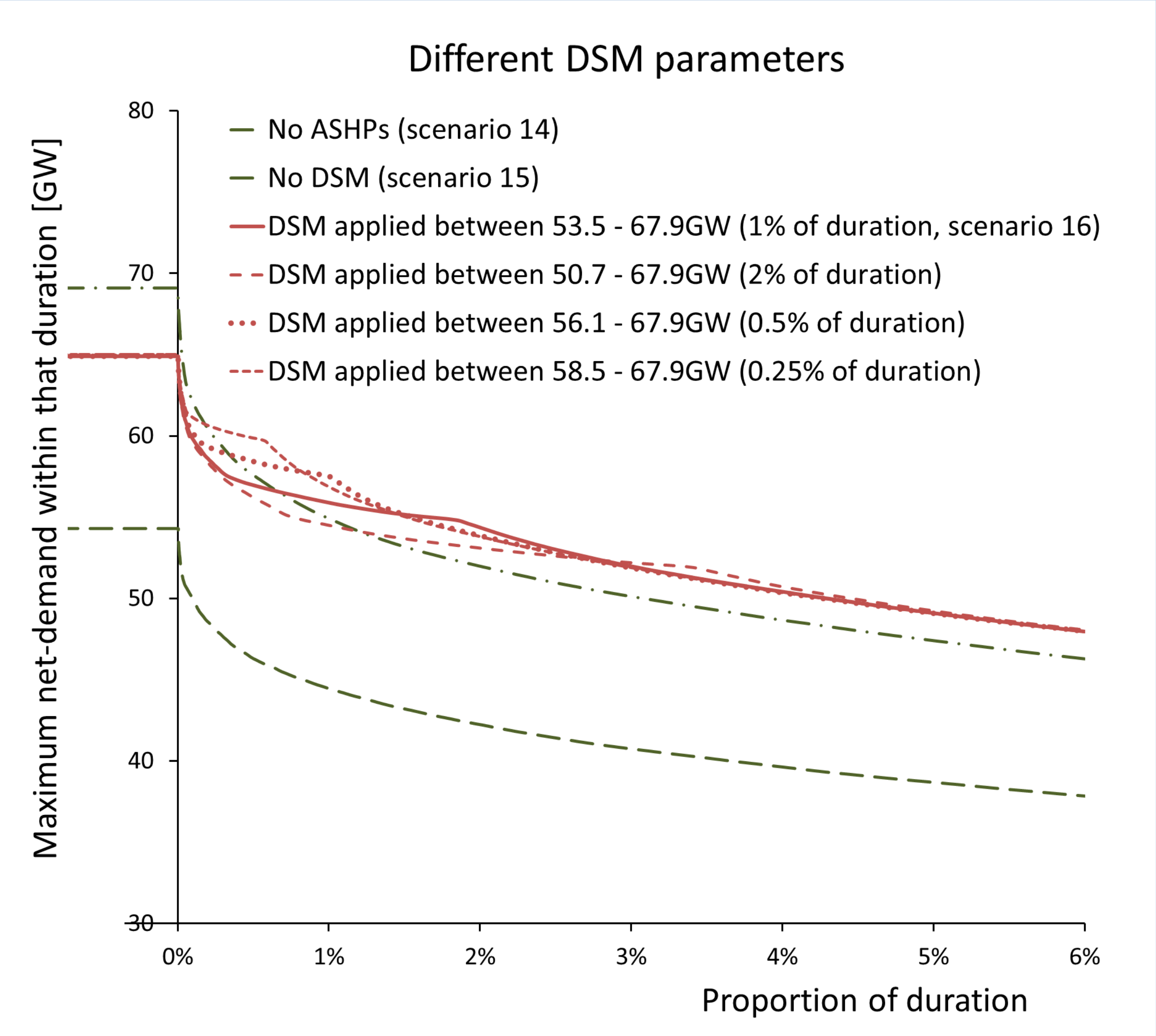


Results

Increase [MW]
14800
10600

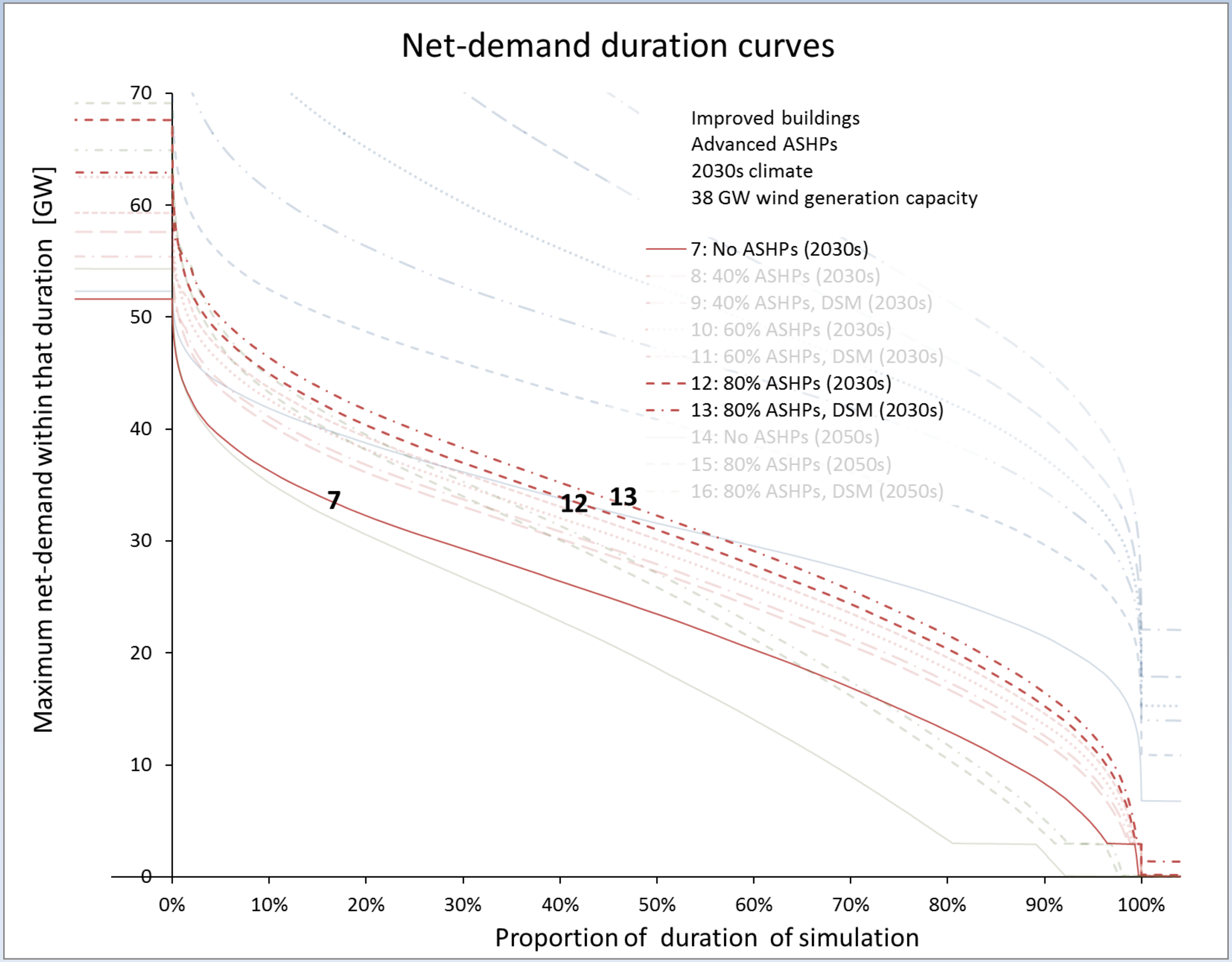


Demand Side Management



Results

Increase [MW}
16000
11300



Conclusions

- Increase is significant but not impossible (12 - 16 GW for 80% usage, 2030s assumptions)
- Can be mitigated by DSM but not as much as simple analysis would indicate (up to around 30%)
- Other factors – appropriate installation, average unit performance, good insulation have greater benefit.

Results - summary

Scenario	DSM?	Peak for <0.002%	Increase	Peak for <0.05%	Increase
0	-	49300	-	48700	-
1	-	52300	-	51300	-
2	N	132500	80200	124700	73400
3	**Y**	119900	67600	116500	65200
4	N	106700	54400	100300	49000
5	N	88500	36200	82500	31200
6	N	73300	21000	68300	17000
7	-	51600	-	49500	-
8	N	57600	6000	54600	5100
9	**Y**	55400	3800	53400	3900
10	N	62500	10900	58100	8600
11	**Y**	59300	7700	56300	6800
12	N	67600	16000	62300	12800
13	**Y**	62900	11300	59700	10200
14	-	54300	-	50800	-
15	N	69100	14800	63500	12700
16	**Y**	64900	10600	61000	10200

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